Title: Attributes of Polygons

Brief Overview:

This Concept Development Lesson will introduce students to polygons, giving particular emphasis to triangles. Students will use manipulatives to construct, classify, compare, and predict outcomes using properties of polygons. Every lesson in this unit includes a literature connection, discussion, exploration, and writing. Some lessons also include an art extension. The class culminating activity is to design and construct a class quilt using triangles and other shapes that are constructed from triangles. It should be noted that the materials used in this unit should be left on a shelf for the students to use for discovery and exploration on their own.

NCTM Content Standard:

Geometry

Students will be able to:

- Analyze characteristics and properties of two dimensional geometric shapes and develop mathematical arguments about geometric relationships
- Apply transformations to analyze mathematical situations
- Use visualization, spatial reasoning, and geometric modeling to solve problems

Grade/Level:

Grades 2-3

Duration/Length:

Four days (45-50 minute lessons)

Student Outcomes:

Students will:

- Recognize, name, and classify polygons
- Classify triangles by sides and angles
- Compare triangles and polygons
- Predict the results of putting together triangles

Materials and Resources:

- Books – The Wing on a Flea: A Book About Shapes, Color Zoo, Angles are Easy As Pie, The Greedy Triangle
- TR1 – geometry cabinet material
- TR2 – Constructive Triangle Box material
- TR3 – Geometric Stick Box material

- TR4 – Detective Adjective Game
- TR5 – Command Cards
- SR2 – Venn diagram
- SR3 – Summative assessment
- Rulers
- Overhead geoboard

Development/Procedures:

Lesson 1

Objective- Students will be able to recognize, name, and classify polygons.

Preassessment – Show students the picture book, Color Zoo, to see how many shapes they recognize and assess their vocabulary.

Launch – Discuss with students that ancient peoples had to solve everyday problems and property disputes without the use of tools we have today. Brainstorm with the children what solutions ancient people may have used to measure land, weigh grain, or build houses and temples. Read the "Story of Geometry" and discuss the method ancient Egyptians used to solve their land disputes. How could this be helpful today?

Story of Geometry – Farmers in ancient Egypt found the banks of the Nile River to be an ideal spot to farm. The land was very fertile and the river provided plenty of water. The farmers did have one problem. Every year the Nile River would flood, overflow the river bank, and cover the farmers' fields. This was not an entirely bad thing though. The flood waters brought rich nutrients to the fields. When the flood receded, the farmers fields had shifted and the boundaries were no longer the same. This created some disputes over land among the farmers. The Egyptians would send a group of people called rope-stretchers into the fields to measure and restate the boundaries. These rope-stretchers used a simple rope to measure areas as large as a field. The ancient Egyptians found that by tying knots in a rope at equal intervals they could make a right angle triangle and then flip the triangle rope on the hypotenuse to create a rectangle. They were the first ones to use the 3, 4, 5 rule in geometry. If they made one of the sides three knots long, and one side four knots long, then the opposite line, called the hypotenuse, would be 5 knots long. The angle created by the three and four knot lines would be a right angle.

Teacher Facilitation – Present students with the geometry cabinet material. (If you do not have geometry cabinet material, see TR1 for directions to make one.) Give the definition of polygons. Take out the triangles from the box. Show students the sides and count them with the students. Have students create the definition of a triangle. Show the students the quadrilaterals and count the sides. After counting each side give the name of the quadrilateral. Write the name of the quadrilateral on a label and place next to the quadrilateral. (There is no need to discuss parallel sides at this time). Show students the polygons from the box. Count the sides of each polygon and give the name for each polygon. Write the name of the polygon on a label and place next to the polygon.

Student Application – Students will trace the shapes from the geometric box onto construction paper and cut them out. On a large wall chart, write the headings Triangle,

Quadrilateral, and Other Polygons. Students are to paste the shapes under the proper headings and label the shape.

Embedded Assessment – In the math journals, students will write the words triangle, quadrilateral, and polygon. Students will then draw a picture to illustrate each word and then write a definition of each word in their own words.

Reteaching/Extension – Students can draw shapes on paper and then draw a picture around the shape to make the shape part of the picture. For example, a pentagon can become a house, a rectangle can become a garden, and a triangle can become a tree. Students will then identify the shapes in their pictures.

Lesson 2

Objective – Students will be able to measure, name, and classify triangles by the length of their sides.

Preassessment – Using the shapes from the geometry cabinet, ask the children to retrieve the shape that is called out by the teacher. Include triangle, square, rectangle, rhombus, parallelogram, trapezoid, and the polygons up to the decagon. Review the chart the students made the day before. You may want to assess the ability of the students to use a ruler to measure as they will need to do this in this lesson.

Launch- Read the story The Greedy Triangle to the class. After reading, ask the students to find objects around the classroom that illustrate the different shapes. Tell students that today they will learn more about triangles.

Teacher Facilitation- Introduce the triangles from the first Constructive Triangle Box. If you do not have a Constructive Triangle Box, please see TR2 for directions to make your own. Give students a copy of TR2 and have them cut out the triangles or have the triangles precut and pass one of each to each student. Give each student a ruler. Have the words equilateral, isosceles, and scalene written on labels placed on a mat on the floor. Show the students the three different triangles. Have students discuss how the three triangles are alike and how they are different. Tell students that they will be classifying triangles by the length of their sides. Have students measure the length of all the sides of the equilateral triangle. Ask students to reason which label will fit that triangle (equilateral). Have students measure the length of all the sides of the isosceles triangle. Ask students which label they think will fit this triangle. (isosceles). Have students measure the length of all the sides of the scalene triangle. Using the process of elimination, what label would fit this triangle? (scalene)

Student Application- Students will use the Geometric Stick Box or a Geoboard to construct triangles. If you do not have a Geometric Stick Box, see TR3 for directions to make this material. Students can also find triangles around the classroom and classify them.

Embedded Assessment- Students will write in their journals the names of the three types of triangles, draw a picture of each (tracing their triangles if necessary), and write a definition of each in their own words.

Reteaching/Extension- Students can measure the sides of the triangles in the Geometry Cabinet (see lesson 1) and classify them by sides. Students can trace the triangles, cut them out, and make a wall chart.

Lesson 3

Objective – Students will be able to name and classify triangles by their angles.

Preassessment – Place an equilateral, isosceles, and scalene triangle on the mat. Ask students to point to the equilateral triangle. Ask them for a definition of this triangle. Repeat these directions for the remaining triangles.

Launch- Read Angles Are Easy As Pie. Tell students that today they will learn another way to classify triangles by looking at their angles.

Teacher Facilitation- Place several triangles on the mat that have right angles, acute angles, and obtuse angles. Tell students that the point where two lines meet is called a vertex. The space made with the two lines and the vertex is called an angle. Count the angles on all the triangles. How many angles do all the triangles have? What can we say about triangles? (All triangles have three sides and three angles.) Tell students that they are going learn about three types of angles. Show students several examples of right angles such as, a corner of a book, a corner of a chalkboard, and the crook of their arm when bent. Using an overhead geoboard, construct a right angle. Have students construct a right angle on their own geoboard if you wish. Tell students that this is called a right angle. (There is no need to discuss degrees at this time. At this point the lesson is emphasizing the sensorial concept). Show the students the right angles on the triangles and label them as right angle triangles.

Tell students that the other angles are determined by comparing them to a right angle. Show students several angles that are obviously less then a right angle. Leave the right angle on the overhead geoboard and illustrate several examples of acute angles showing their relation to the right angle. Students can make their own angles on their geoboards if you wish. Show students that the angles do not take up the space of a right angle. Tell them this is called an acute angle. Have students determine which triangles on the mat contain acute angles and label them.

Show students several angles that are obviously larger than a right angle. Leave the right angle on the overhead geoboard and illustrate several examples of obtuse angles showing their relation to the right angle. Students can make their own angles on their geoboards if you wish. Show students that the angles take up more space than the right angle. Tell them this is called an obtuse angle.

Student Application- Students can work together in groups to complete the Detective Adjective Game. If you do not have this material, see TR4 for directions how to make your own.

Embedded Assessment- In their journals, students will write the words right angle, acute angle, and obtuse angle. Students will draw an example of each (tracing triangles if needed) and write a definition for each in their own words.

Reteaching/Extension- Using the Geometric Stick Box or flex straws, have students create the triangles from the command cards. See TR5 for command cards.

Lesson 4

Objective – The students will be able to compare triangles and quadrilaterals, and predict the results of putting triangles together.

Preassessment – Place several kinds of triangles on the mat. Ask students to work together to classify the triangles by sides and angles. Each student will select a triangle to present to the class.

Launch – Read The Wing on a Flea: A Book About Shapes. Tell students that today they will learn how triangles can be put together to make different shapes.

Teacher Facilitation – Give each student **two** copies of TR2 (Constructive Triangle Material) or have the triangles precut and pass out a set to each student. Ask students to find two equilateral triangles and slide them next to each other. What is formed? (quadrilateral, rhombus). Ask students to find two isosceles triangles and slide them together. What is formed? (quadrilateral, parallelogram). Ask students to find two scalene triangles and slide them together. What is formed? (quadrilateral, parallelogram). Ask students to find two right angle isosceles triangles and predict what will be formed when they slide them together. What is formed? (quadrilateral, square). Ask students to find two right angle scalene triangles and predict what will be formed when they slide them together. What is formed? (quadrilateral, rectangle).

Student Application – Students will trace the quadrilaterals that were formed and color the triangles in each. Students can also explore with the triangles to see what will be formed when an equilateral triangle is connected with a scalene triangle, or put three triangles together. This should be time for discovery.

Embedded Assessment – Students will choose two quadrilaterals that were formed and complete a Venn diagram (SR1) to compare and contrast. The students will then write a paragraph comparing the two quadrilaterals using the Venn diagram as a guide.

Reteaching/Extension – Show students several examples of quilts. Bring in several quilt books to discuss the patterns found in most traditional quilts. Students can create quilt squares using triangles. If desired, students can use fabric paint or crayons to transfer their finished designed to fabric and create a class quilt to hang on the wall.

Summative Assessment:
Assessment is an ongoing feature of this unit. Teachers are to use observation, interview, and journals to assess student understanding. Students can take a summative assessment that follows the MSA format on SR2.

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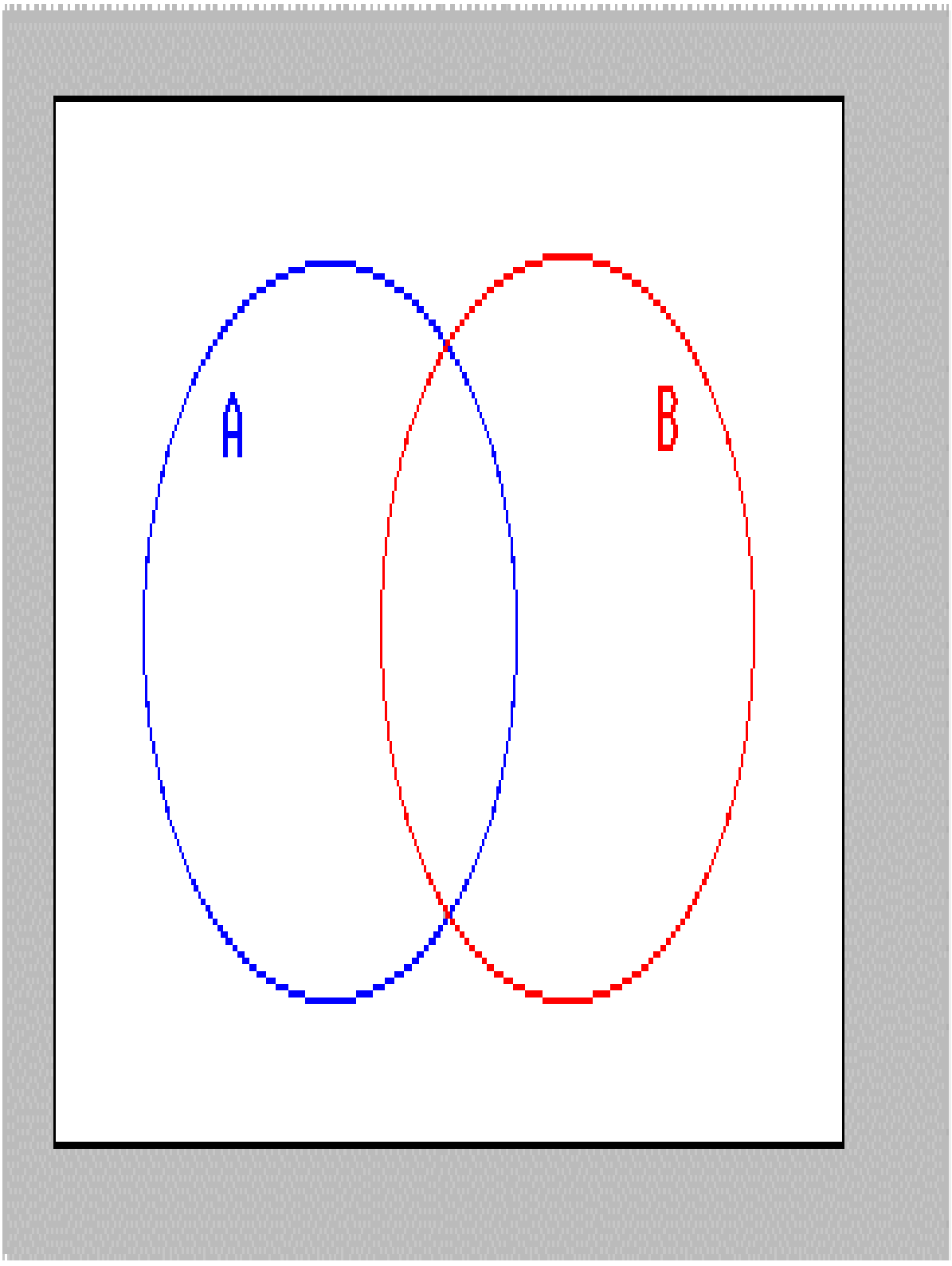
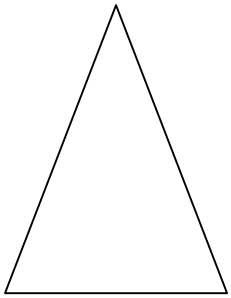
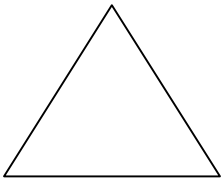
Venn Diagram

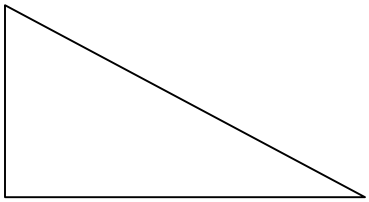


Assessment

1. Label the following triangles as equilateral, isosceles, or scalene.







2. What shape will you make if you put two scalene right angle triangles together?

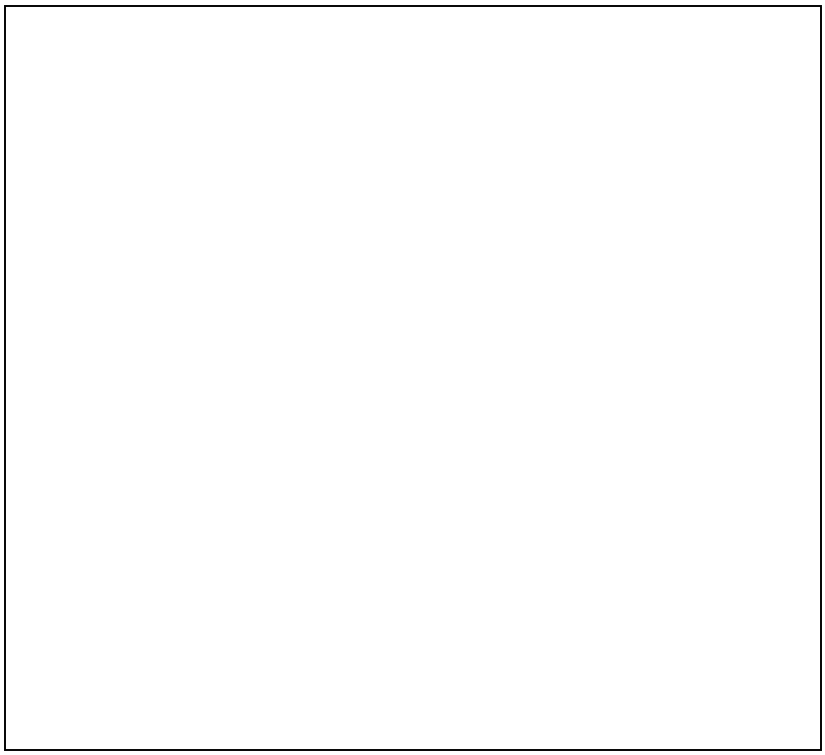
_____

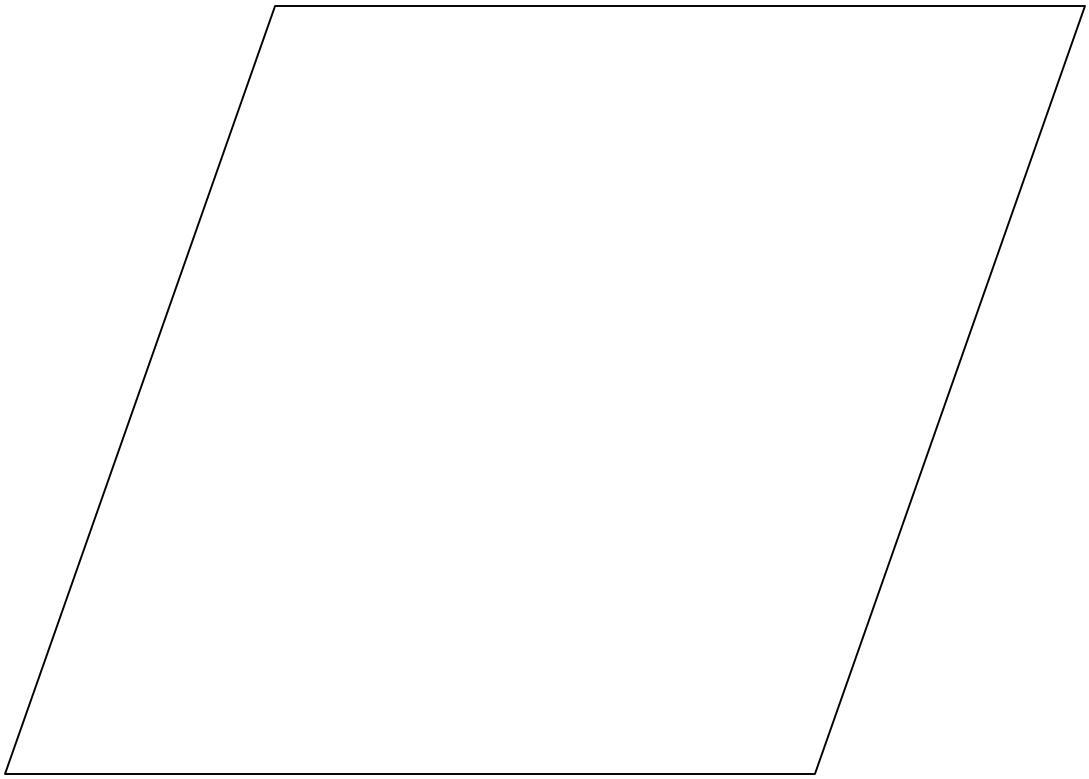
2. How do you know your answer is correct?

_____

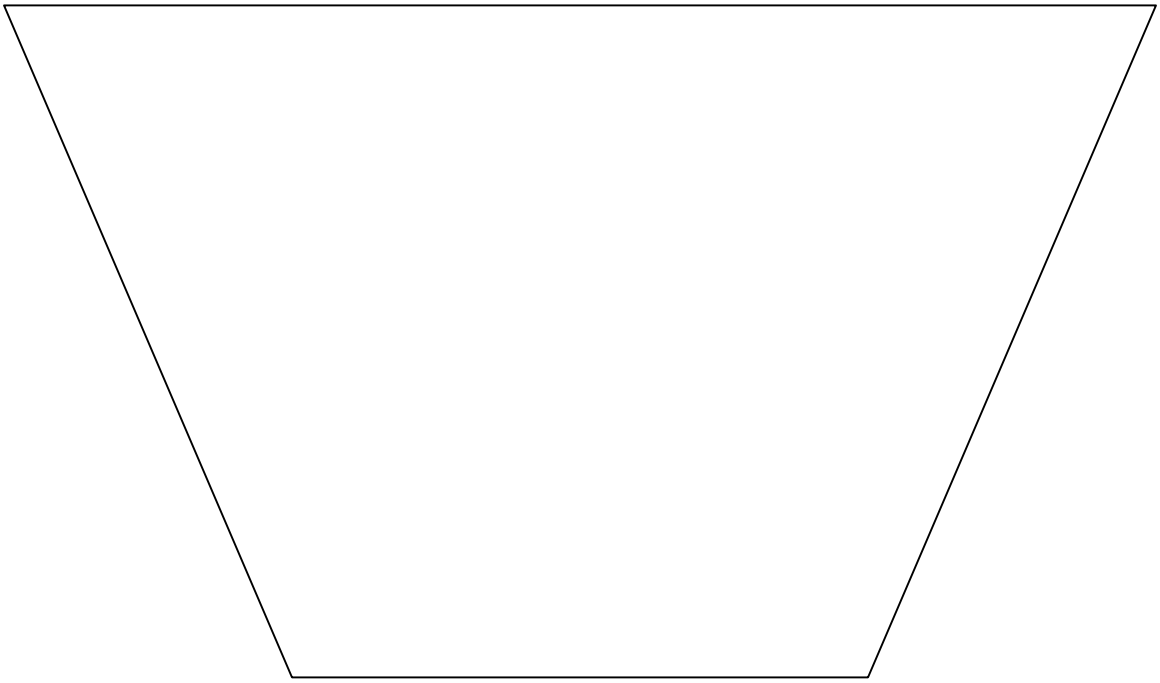
_____

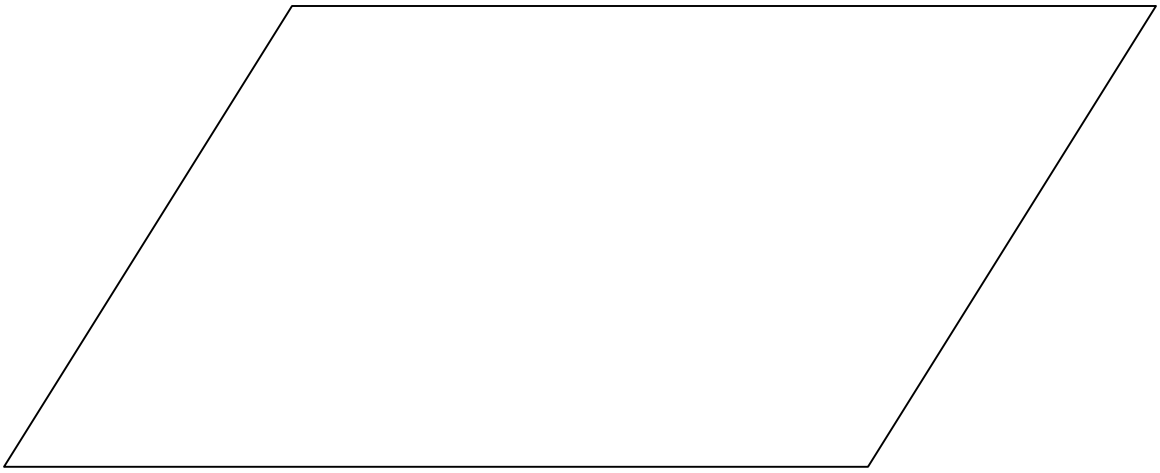
Geometry Cabinet Material – Reproduce each set onto heavy cardstock and laminate.





Geometry Cabinet Material





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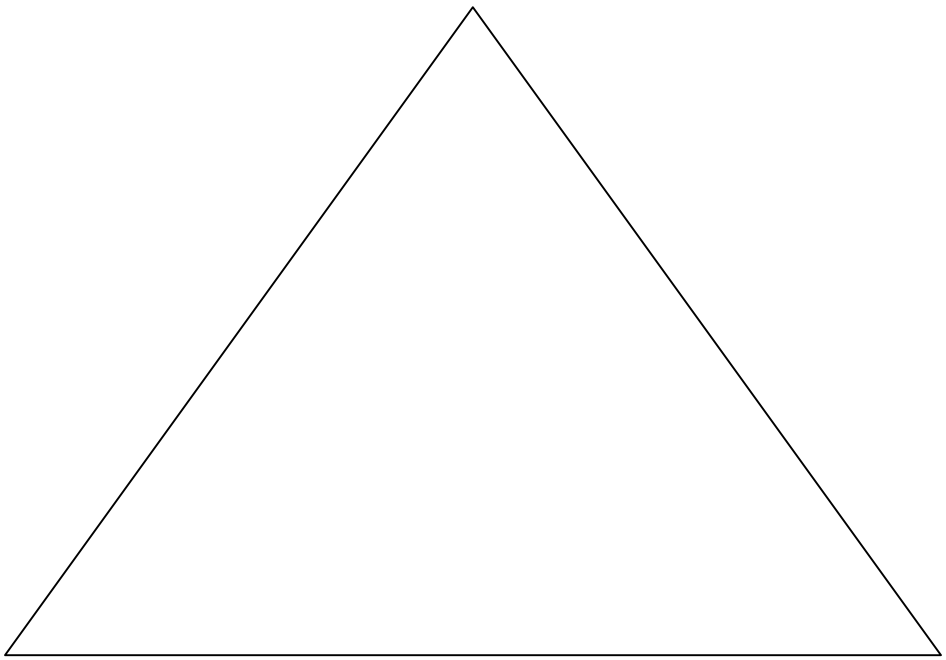

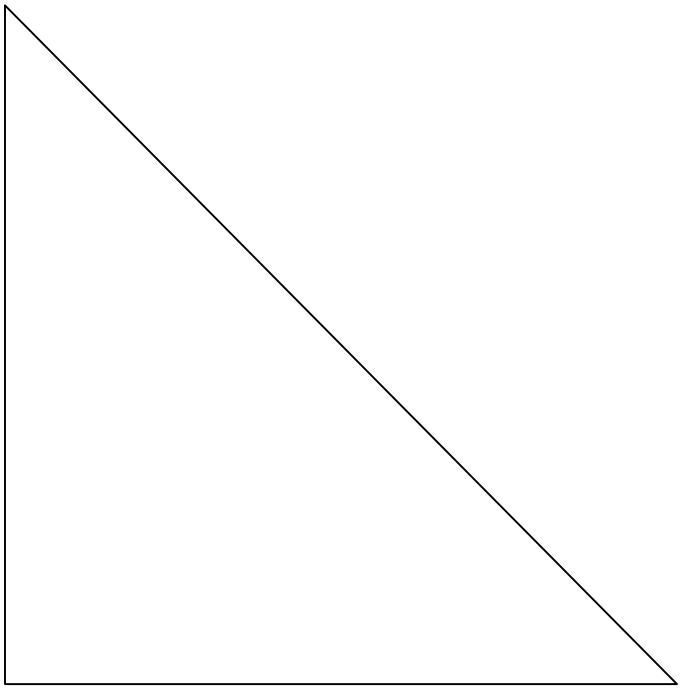

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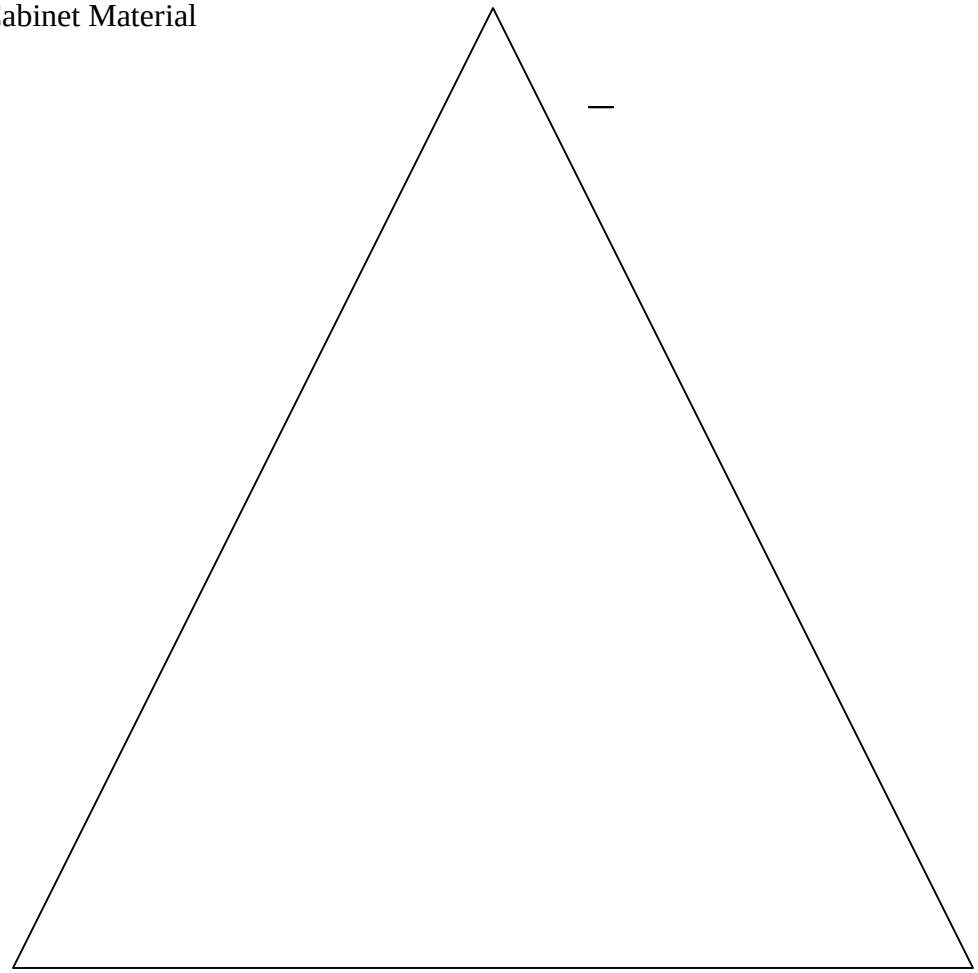

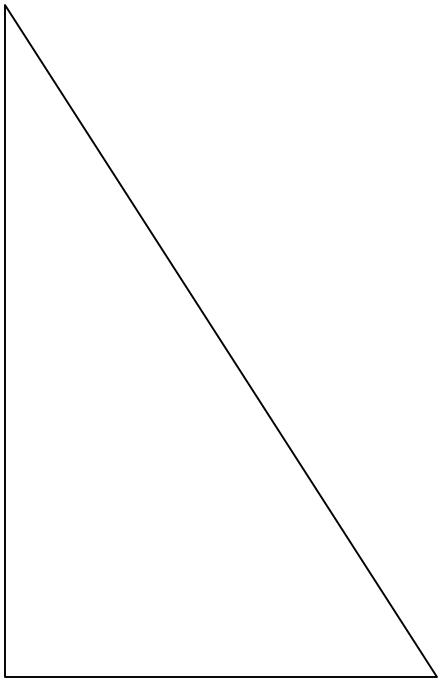

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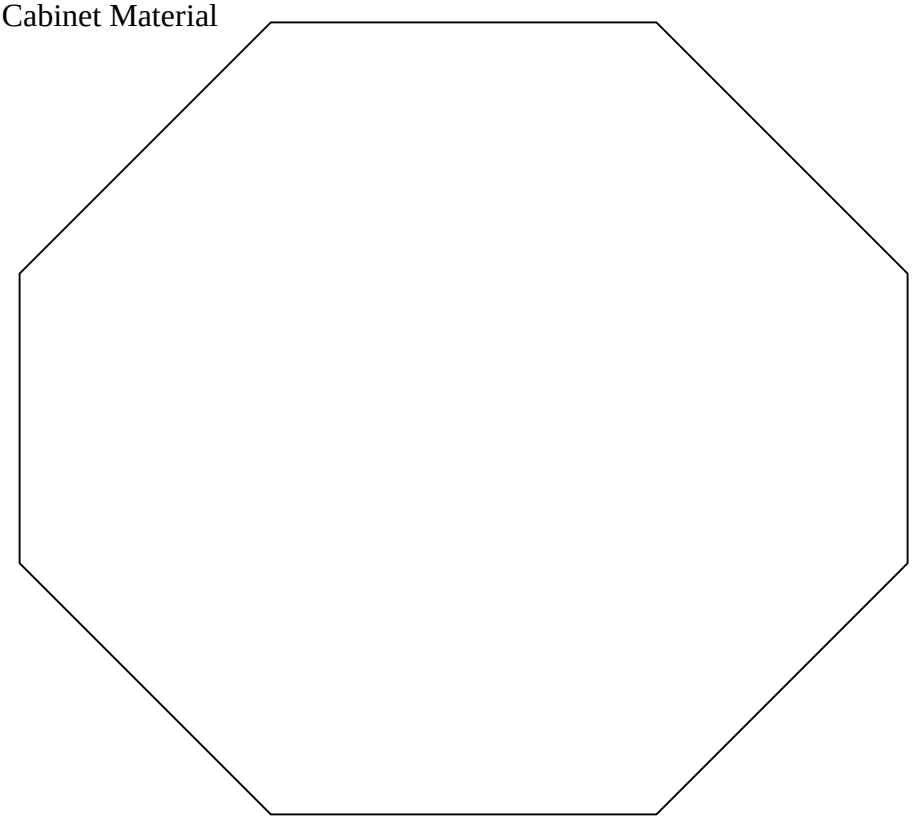

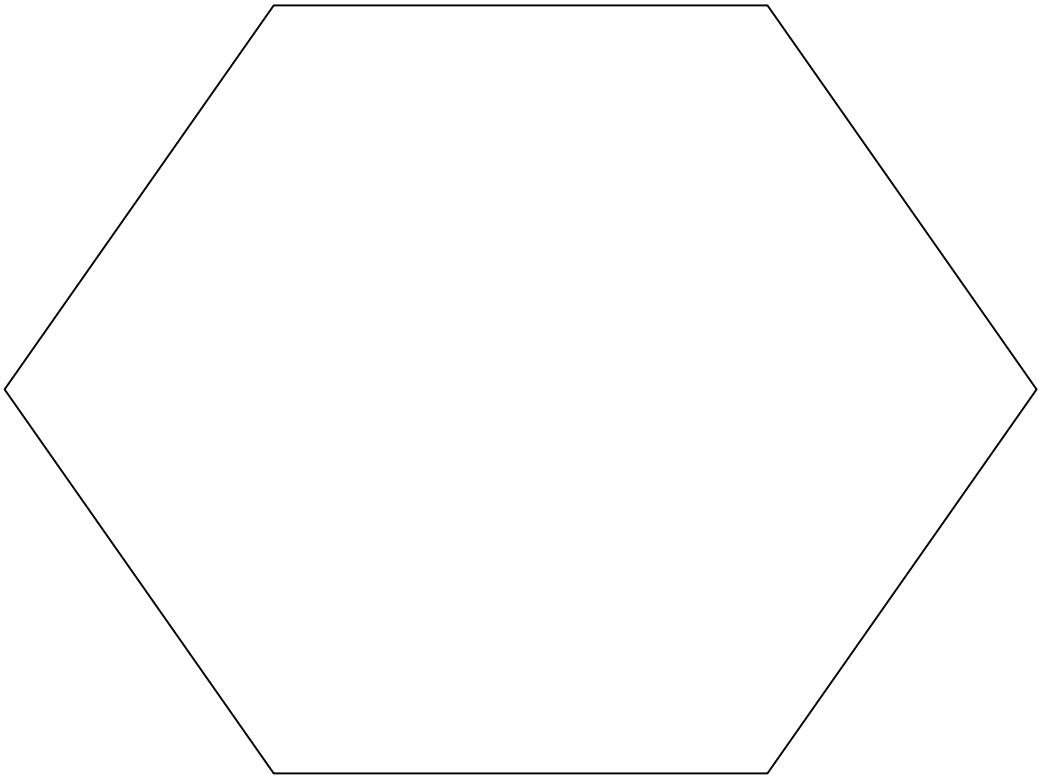

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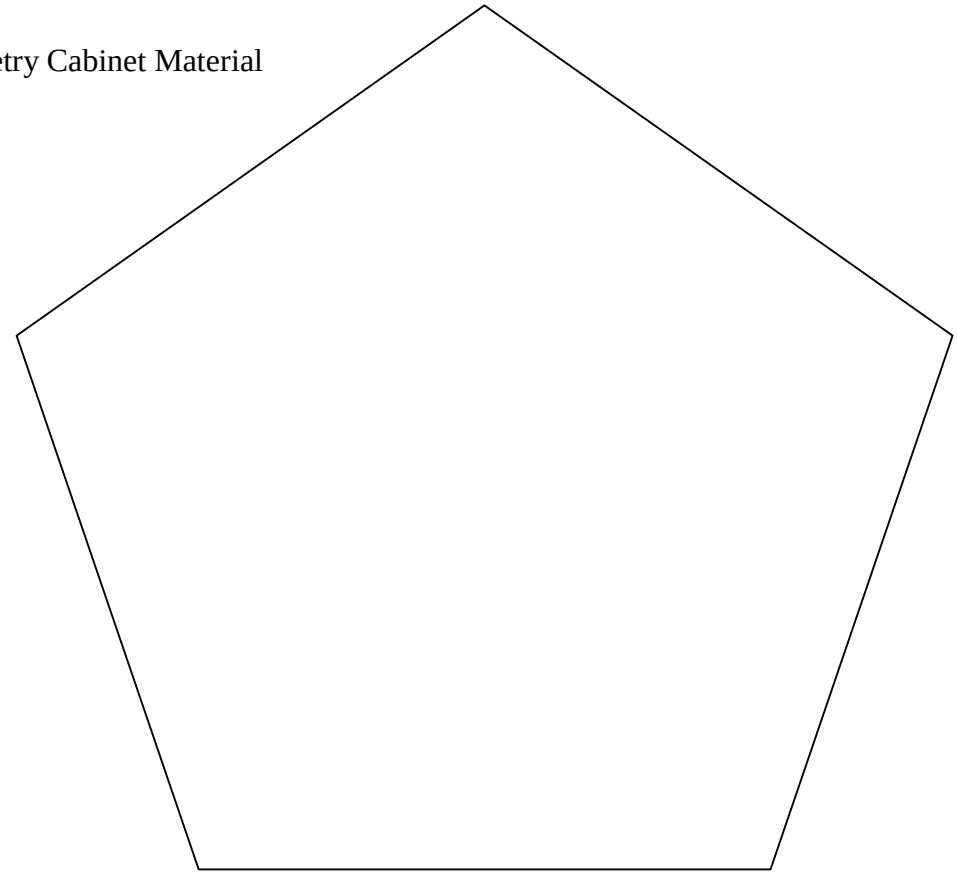
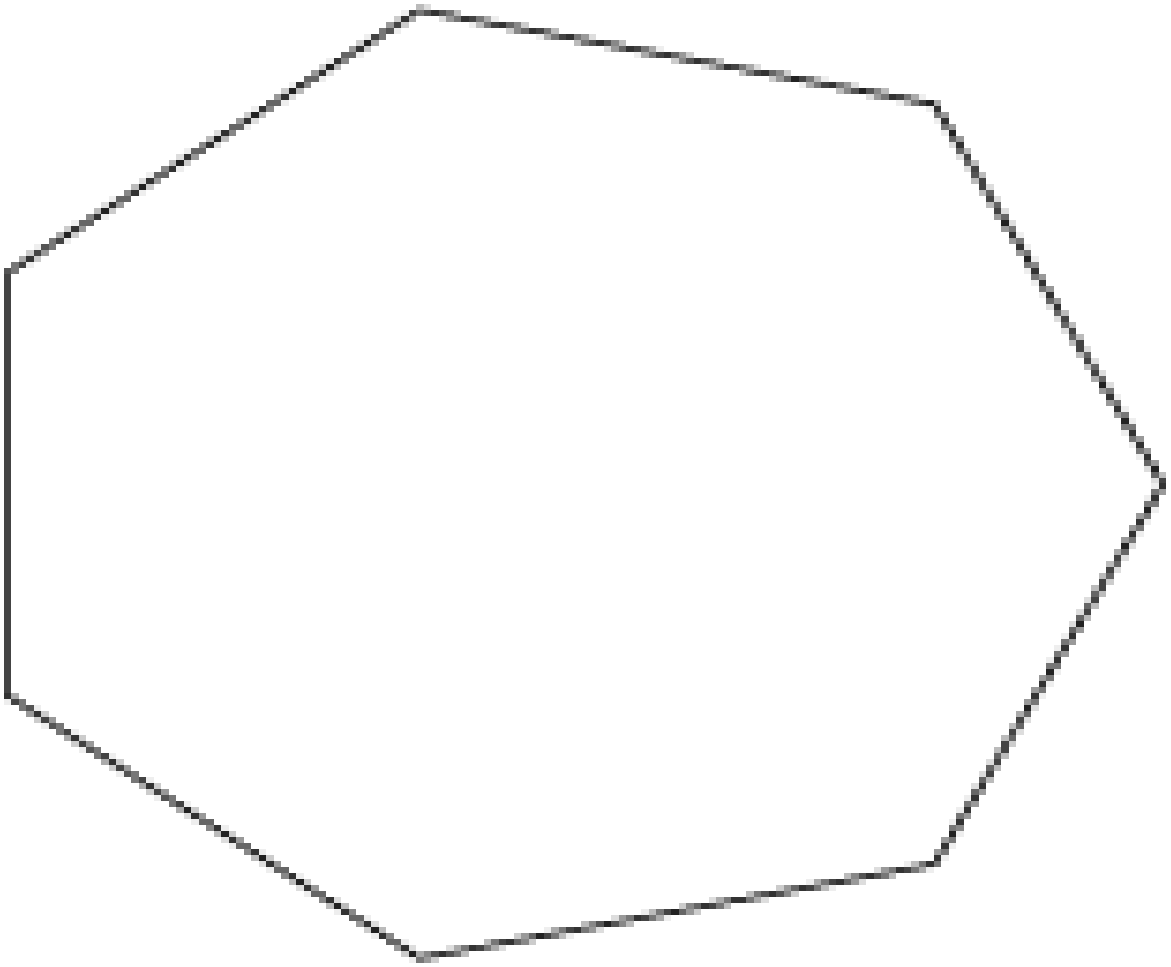
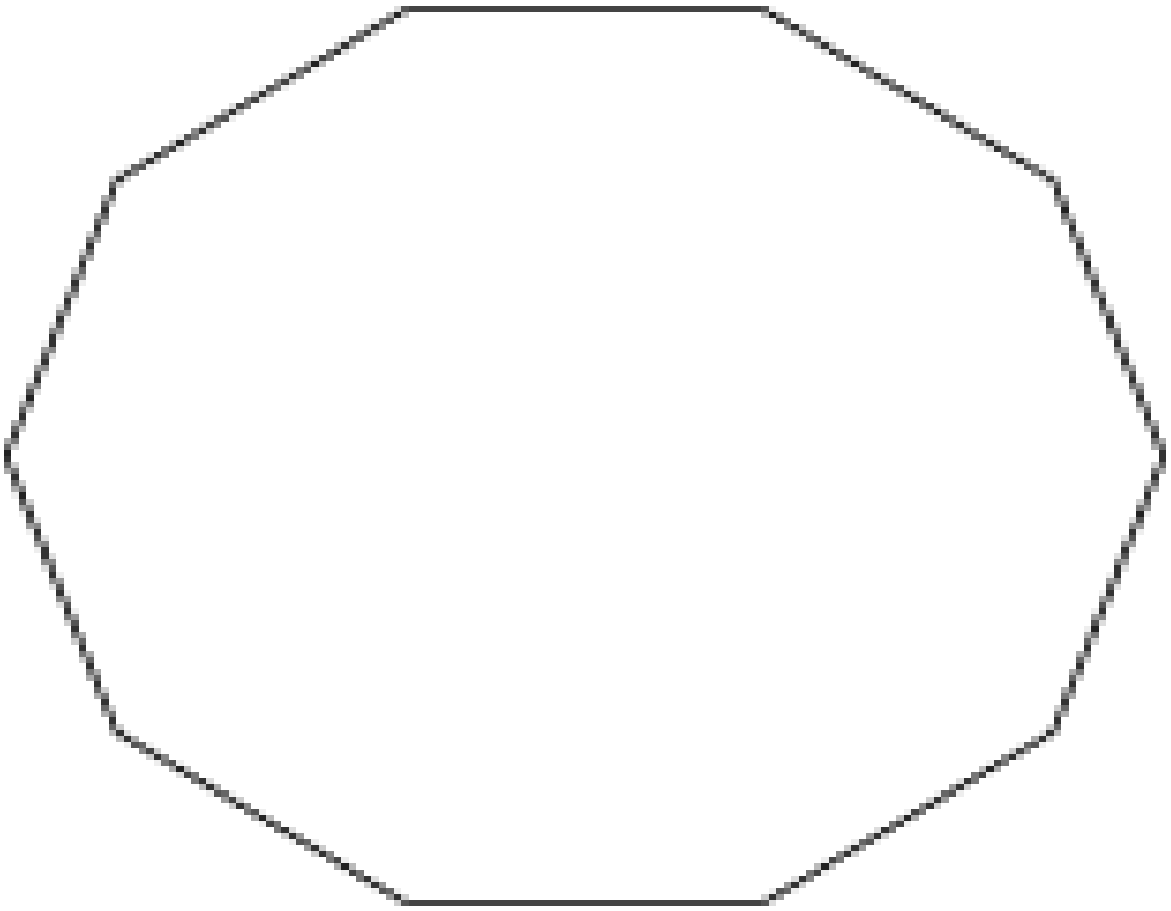




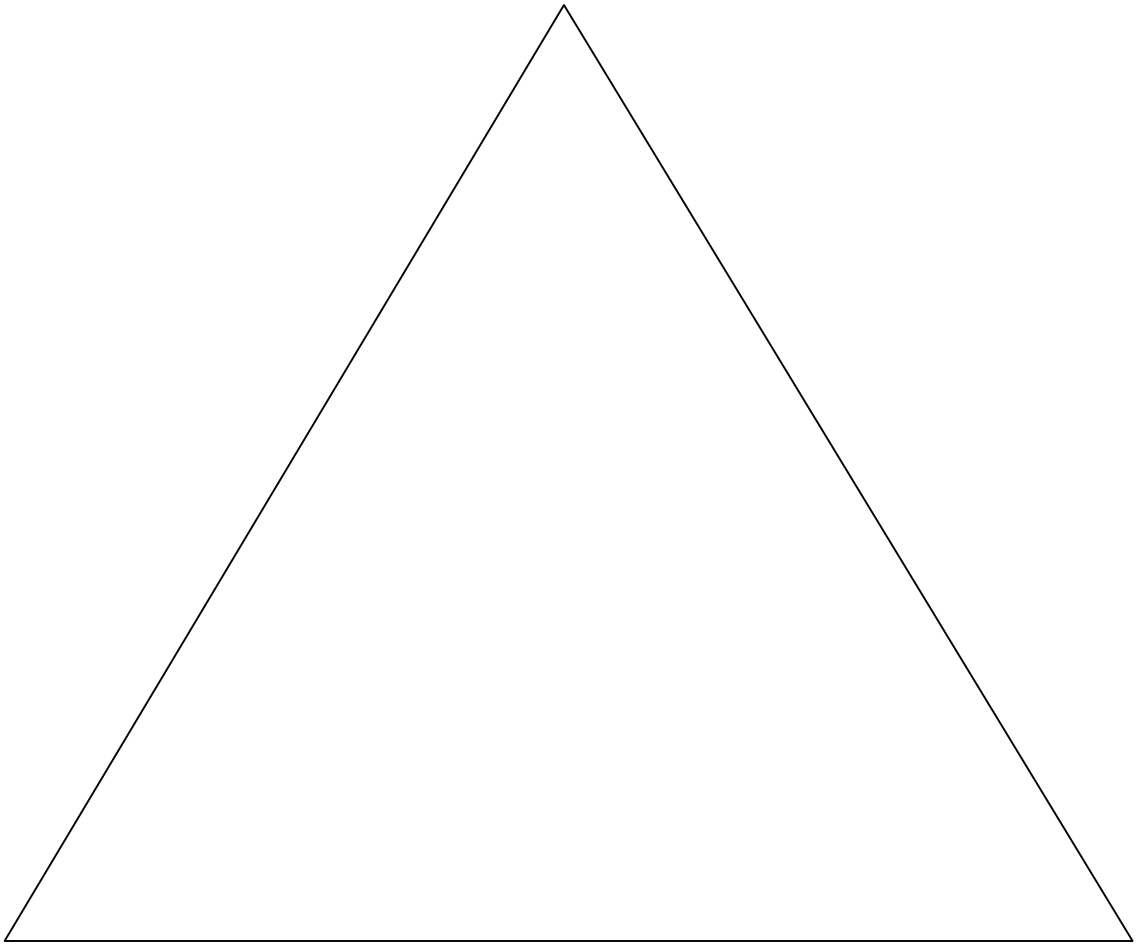


Geometry Cabinet Labels

Square
Parallelogram
Trapezoid
Rhombus
Triangle
Pentagon
Hexagon
Heptagon
Octagon

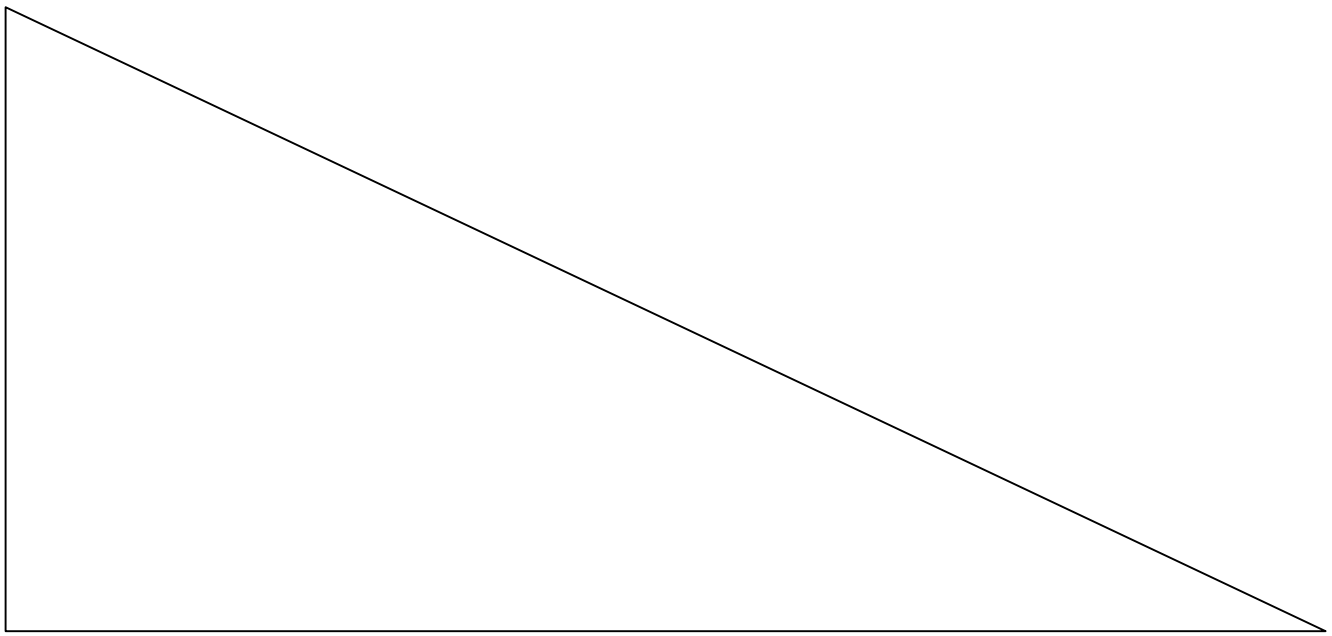
Nonagon
Decagon

Constructive Triangle Box – This material consists of three of each type of triangle- equilateral, isosceles, and a right angle scalene. I suggest that each type of triangle be a different color. Remember, make **three** of each of these triangles.



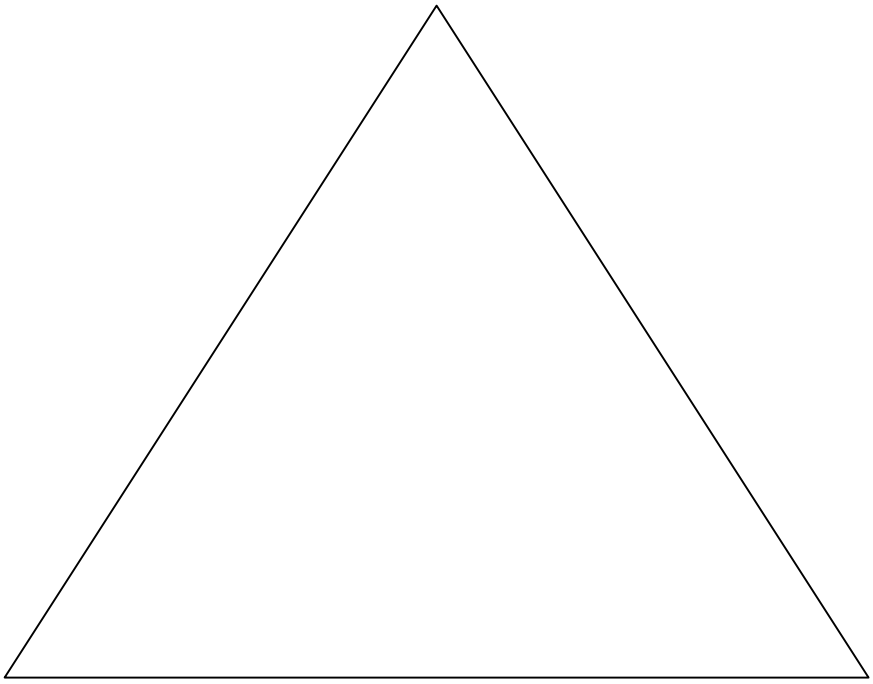
Isosceles

Constructive Triangles Box



Scalene

Constructive Triangle Box



Equilateral

Directions for Geometric Stick Box

A geometric stick box is constructed of wooden sticks cut at 10 different lengths. Each length is colored a different color. You can make a material that will demonstrate the same attributes by using flex straws. If possible, use at least 4 different colored straws making sure the straws have a flex bend in them. Cut each color to a different length. For example, red straws can be left at full length. Blue straws should be cut in half so that it takes two blues to make a red. Green straws should be cut into fourths. It is important that the length be measured from the bottom of the flex bend to the end of the straw. Do not include the bend of the straw into the measurements.

Next, cut a slit from the top of the straw to the flex bend. Make sure you stop cutting at the flex bend. Students can then insert the end of one straw into the cut end of another straw to create their polygons.

Other materials that can be used for this material are pipe cleaners, and craft sticks. Just be sure to color code the lengths.

Detective Adjective Game – This material is traditionally used to help teach adjectives in grammar, but I have found it useful to reinforce the attributes of triangles. This material consists of triangles in four different colors and three sizes. There are many different types of triangles in each category. Students use the clue strips and find the triangle to match the clues. Using the chart below, make the following triangles.

Large/Blue	Medium/Blue	Small/Blue
Equilateral	Equilateral	Equilateral
Scalene/Right angle	Scalene/Right angle	Scalene/Right
Scalene/Obtuse	Scalene/Obtuse	Scalene/Obtuse
Isosceles/Right	Isosceles/Right	Isosceles/Right
Isosceles/Obtuse	Isosceles/Obtuse	Isosceles/Obtuse
Isosceles/Acute	Isosceles/Acute	Isosceles/Acute

Repeat the previous triangles using large, medium, and small and the colors red, yellow, and green. You should have 72 triangles when you are done. Laminating is recommended so students can explore this material often.

Detective Adjective Game Clues- These clues should be copied onto cardstock, cut into strips, and laminated.

Large, blue, equilateral

Large, blue, scalene, right angle

Large, blue, scalene, obtuse angle

Large, blue, isosceles, right angle

Large, blue, isosceles, obtuse angle

Large, blue, isosceles, acute angle

Medium, blue, equilateral

Medium, blue, scalene, right angle

Medium, blue, scalene, obtuse angle

Medium, blue, isosceles, right angle

Medium, blue, isosceles, obtuse angle

Medium, blue, isosceles, acute angle

Small, blue, equilateral

Small, blue, scalene, right angle

Small, blue, scalene, obtuse angle

Small, blue, isosceles, right angle

Small, blue, isosceles, obtuse angle

Small, blue, isosceles, acute angle

Large, red, equilateral

Large, red, scalene, right angle

Large, red, scalene, obtuse angle

Large, red, isosceles, right angle

Large, red, isosceles, obtuse angle

Large, red, isosceles, acute angle

Medium, red, equilateral

Medium, red, scalene, right angle

Medium, red, scalene, obtuse angle

Medium, red, isosceles, right angle

Medium, red, isosceles, obtuse angle

Medium, red, isosceles, acute angle

Small, red, equilateral

Small, red, scalene, right angle

Small, red, scalene, obtuse angle

Small, red, isosceles, right angle

Small, red, isosceles, obtuse angle

Small, red, isosceles, acute angle

Large, yellow, equilateral

Large, yellow, scalene, right angle

Large, yellow, scalene, obtuse angle

Large, yellow, isosceles, right angle

Large, yellow, isosceles, obtuse angle

Large, yellow, isosceles, acute angle

Medium, yellow, equilateral

Medium, yellow, scalene, right angle

Medium, yellow, scalene, obtuse angle

Medium, yellow, isosceles, right angle

Medium, yellow, isosceles, obtuse angle

Medium, yellow, isosceles, acute angle

Small, yellow, equilateral

Small, yellow, scalene, right angle

Small, yellow, scalene, obtuse angle

Small, yellow, isosceles, right angle

Small, yellow, isosceles, obtuse angle

Small, yellow, isosceles, acute angle

Large, green, equilateral

Large, green, scalene, right angle

Large, green, scalene, obtuse angle

Large, green, isosceles, right angle

Large, green, isosceles, obtuse angle

Large, green, isosceles, acute angle

Medium, green, equilateral

Medium, green, scalene, right angle

Medium, green, scalene, obtuse angle

Medium, green, isosceles, right angle

Medium, green, isosceles, obtuse angle

Medium, green, isosceles, acute angle

Small, green, equilateral

Small, green, scalene, right angle

Small, green, scalene, obtuse angle

Small, green, isosceles, right angle

Small, green, isosceles, obtuse angle

Small, green, isosceles, acute angle

Command Cards for Geometric Stick Box or flex straws

Copy these commands onto cardstock. Cut out to make individual cards and laminate.

Make an equilateral triangle.

Make a scalene triangle.

Make a scalene, right angle triangle.

Make a scalene, obtuse angle triangle.

Make an isosceles triangle.

Make an isosceles, right angle triangle.

Make an isosceles, obtuse angle triangle.

Make an isosceles, acute angle triangle.

Make a square.

Make a rectangle.

Make a rhombus.

Make a parallelogram.

Make a trapezoid.

Make a pentagon.

Make a hexagon.

Make a heptagon.

Make an octagon.